

“We Must All Work: Promoting Women in Science,” *Proceedings of the International Conference on Women in Science*, Anna University, Chennai, India, December 2000.

Believe it: We All Have to Work!

by Dr. Frances A. Rosamond

Introduction

Thank you for the opportunity to join this outstanding Seminar on Academic Challenges for Women in the 21st Century. Certainly the patrons, advisors, co-ordinator, co-coordinators and organizers deserve generous applause for their vision and planning. I apologize in advance for my misconceptions and limited understanding of the challenges faced by women of India and for only writing from the perspective of a westerner. This is my first visit to India. One of the things that has impressed me most is the constant activity-- people are never sitting idle. People are constantly busy: teaching, studying, doing research, sweeping, cooking, planting, weaving, sorting, digging. People are constantly working. And so I have chosen “Believe it: We all have to work!” as the theme of my talk.

Whatever we do in life, we will work. There is a popular western children’s fantasy story in which a poor girl is married by a handsome prince who takes care of her and she no longer needs to work. The tale of Cinderella is so compelling that many a little girl grows up thinking her own prince will come. Even some adult western women cannot let go of the fairy tale. There are cultures where girls grow up thinking that they will always have someone to take care of them...that they will never have to earn their own livelihood. The way of the world today is that women contribute financially to the household. It is important that a little girl gets a clear picture of this reality into her mind early—as early as do little boys.

The women’s movement in the United States in the 1970’s began with an outcry against the poor earnings of women and the difference in wages for equal work. It gradually became clear that women earned more when they worked in science related fields than in the service sector and so researchers began to look at the situation of women working in the sciences. At the University of Santa Barbara in California Professor Paul Ernst suddenly noticed that all the secretaries in the mathematics department were women and the entire faculty was men. Researcher Lucy Sells found that 90% of the females entering Berkeley did not have the secondary school background to go into science. Unless they did remedial study, these girls had to go into service majors at Berkeley.

Attention then turned to secondary schools where it was found that girls were being advised, “Don’t spoil your excellent grade-point average by taking a math class. You will just marry anyway.” Researchers debunked the false notion that women do not work after marriage. Many workshops, special classes and conferences such as the Expanding Your Horizons (Lawrence Hall of Science) series and Kovalevskia Conferences (Sonia Kovalevskia was the first woman to receive a doctorate--it was in mathematics.) were—

and still are, held to educate teachers, parents and students about mathematics avoidance, anxiety, and issues of women in science.

A 1999 report from United States National Science Foundation states that recent studies still show women earning between 71-74 cents for every dollar earned by men, however the median salary for women in engineering is higher than that for the general population. A woman in engineering earns 87 cents for every dollar earned by men [LY99]. The U. S. Census Bureau collects data relative to the U.S. labor force. In a 1998 report [USCB98], the Bureau states that since 1951, the proportion of married women in the labor force has almost tripled. “Since 1967, the proportion of full time, year-round workers who were women increased from 29 percent to 41 percent. Since 1960, the earnings of these women rose 54 percent...to a female-to-male earnings ratio that is currently at an all-time high of 0.74.”

Visiting the Village

In India, I have had the priceless experience of visiting many schools. During friendly conversation at a local restaurant one of the waiters invited us to visit his native place, a small village about six hours by bus south and inland from Chennai, a small poor rural village of about 25 mud-walled, thatched-roofed huts. This was a brave invitation as the waiter had no idea how we might react to sitting on the floor and eating off banana leaves, or sleeping on the floor. The family is tremendously loving and kind and the countryside is the most beautiful we have ever seen. Our waiter friend works in Chennai not because he prefers Chennai, in fact his wife and child live in the village--but because he is the sole provider for his entire family that includes his in-laws as well as his own parents and other family members, at least eight people.

We returned to the village a second time to give workshops at neighboring schools about the mathematics of computer science—schools with no chairs or desks or libraries, but with super keen and enthusiastic students. The headmaster or mathematics teacher translated into Tamil. One of our workshop activities is the Sorting Network, a physical model of parallel computing with network lines and comparison nodes made out of colored tape on a big blue tarp. Children carry inputs--values that can be put in order, such as a numbers. They start on one end of the tarp with the numbers in mixed order, walk along the network making comparisons and eventually come out in sorted order at the other end.

One reason for sharing this example is my conviction that as scientists, we must find ways to make the latest thinking and the unsolved problems in our field accessible at every level. Sorting algorithms are usually a topic in a graduate or 4th year course in Algorithm Design, yet the fundamental notions are available to 6-year old children [BWF99]. If we want our children—girls and boys, to become excited about the mathematical sciences—and we do--then we must find ways of sharing with them our pleasure in what we do. Two models for conceiving brilliant projects of mathematical science popularization include the charismatic and thoughtful scientist R. Ramanujam of the Institute for Mathematical Sciences in Chennai who helped start the Tamil Nadu Science Forum which also publishes the Janta Mantar children’s science magazine

[JM00], and Professor K. G. Nair, who at Cochin University has built and directs the best children's science park that I have ever seen.



The Sorting Network

Values flow through the network from left to right. At each comparator node of the network, two values enter from the left and exit from the right, with the larger value (by agreement) exiting below the smaller value. The key property of the network is that no matter how the input values are scrambled, they always exit from the network in sorted order.

Another reason for mentioning the sorting network is the observation that when six children were invited to come stand on the tarp, the boys tended to come first and eagerly while the girls held back. I believe the girls will be less shy about their schooling if they realize that eventually They Must Work. A girl who understands that it is very possible that she will be responsible for herself and possibly eight other people is going to have a different attitude towards learning. Our job it to help our girls realize that as adults they will work at *something*. It may be that they will work at planting rice or weaving or the “invisible” work that is not accorded a category in a nation's gross national product. But, it is possible that they can choose science instead, where they will have a good income, a good work environment, and opportunity for important service and interesting things to think about.

Being Visible: We are the Role Models

Helping our girls (and boys) see science as one of their options means that each of us must be part public relations-part scientist. When we write an article for a newsletter, put our picture with the article. This way, even if a person doesn't read the article, they will notice that it is a *science* article *and* written by a woman.

Let's put science articles into the women's magazines. Science is exciting and we love our field and what we do. Let's tell other women how much fun we are having. We can learn to learn to write science articles that appeal to women who are used to only reading about food and fashion. We do have to work, but working at science is not drudgery.

Take every opportunity to be "on stage". Of course, do what feels comfortable, but taking this advice benefits the presenter as much or perhaps more than the audience. Women sometimes feel they are invisible. They do not receive as much recognition and appreciation as they deserve *and need*. We all need recognition and appreciation. If we don't get the amount that we need, we unconsciously resort to inappropriate behavior in order to get it. Keep a mental awareness of your "appreciation quota" and make sure you are receiving enough.

Joining Together at every level

We must form women's professional associations, develop informal women's networks of administrators, and create math and science clubs. This conference is an excellent example of women joining together. Joining together to discuss common concerns is important at every level. I recall Shelia Tobias saying that when she was Associate Provost at Wellesley she and other women in administration in the northeast area met regularly. They called themselves the "A-Team" because they each had an A in their title: Associate, Assistant, Acting...not the Provost, Chancellor or Dean. Of course, times have changed and these women now have full titles.

There are many professional associations that support women in the mathematical sciences, such as the Association for Women in Mathematics (AWM), Women in Operations Research (WORMS), the International Organization for Women in Mathematics Education (IOWME). In the United States there is a Combined Association of Women in the Mathematical Sciences consisting of representatives from each of these various associations. Many actions to support women in science have resulted from work by these and many other organizations. Two important actions are the following.

- Blind reviewing of articles. Research shows that when the exact same article is submitted for publication--once with the author having a male name and a different time with a female name, then a submission with a male author is more likely to be accepted. Many publications now have blind reviewing of submissions. Other research on publishing has shown that joint authorship results in greater acceptance. Women who think that they must be strongly independent and only submit as a sole author should note that solely authored papers are not accepted as often [R89].
- Insisting on textbooks with pictures of children in non-stereotypic activities. School boards insisted that textbooks only be adopted if they did not promote stereotypes. Now it is equally likely to see a picture of a little boy sweeping the floor or a little girl reading the newspaper.

For many years I was a member of the Mathematical Association of America (MAA) Committee to Increase the Participation of Women in the MAA. Several accomplishments of this committee were the following.

- (1) Committee meeting times and places were made public information and it was made clear that meetings were open to anyone interested in attending.
- (2) Committee chairs circulated openings on a committee to the entire MAA membership and took nominations. In the past chairs simply filled open positions with people they knew. If they didn't know any women, then women didn't get on the committees—Awards Committee, Speaker Selection Committee, Finance Committee, places where important decisions are made. If any woman wants to rise to leadership, wants to join the action zone where policy is decided, then an excellent way to start is by working on a committee. She will make friends and her talents will become known to men and women colleagues.
- (3) The Skit Program. The Skit Program [R99][R96][R94] is a presentation of small skits depicting true events against women that had taken place at the previous annual MAA meeting—only the names changed to protect the guilty. The skits provided a way to raise the issues in a way that we could recognize and laugh at ourselves. The entire program was about two hours in length with the last 45 minutes devoted to the audience sitting in small groups with a leader to discuss how to make positive changes. The skit program continued for over ten years at annual meetings. Attendance was in the hundreds.

College and Graduate Students can meet to share interests and concerns and to mentor younger students. Cornell University mathematics department, as at many other universities, has an extensive seminar series. Speakers come from all over the world to give talks. Whenever a woman came to speak, we women students invited her to speak to us separately—“Tell us how you do it. Tell us about your life. Tell us what keeps you going. How do you manage?” We were inspired and learned many tips from these women who had already succeeded beyond our dreams.

Going beyond the Science

As department chair for mathematics and natural sciences at National University in San Diego, California for over 15 years, I have interviewed many people for employment—and women often do not know how to present themselves at an interview. They do not bring extra copies of their resume, supporting documents or know how to follow up after the interview. We seasoned teachers can expand our role to include helping female students understand what they must do to become employed. We can be mentors for all of our students—introduce them to research strategies, help them write a paper, take them to professional meetings, encourage them to speak or make a paper presentation—don't wait until they are in graduate school. Do this when they are beginning college as well.

Students—your teachers are giving you the deep understandings of their mind. They are caring about you in every way. They are your second mothers and fathers. Write home! Keep in touch with your teachers. Let them know where you are and what you are doing.

Being Aware of Social Constructions so that We Can See Choices

The book, “Games Your Mother Never Taught You” by Betty Lehan Harragan is a classic description of the military and sports metaphors used in the corporate world and also applicable to academia. The details on how to choose and design our office, how to speak, act, in order to be taken seriously in a masculine constructed work environment may be less applicable today than when the book was first published in the 70’s, but the general principles are important information. We may vaguely feel that something is not quite right in our work situation. It may be that we are feeling the difference between our own personal way of thinking about the situation and the more socially accepted masculine perspective. If we can get a clearer understanding of some of the differences, then we will be in a position to say that in some cases we choose the male perspective, in other cases we choose the female, in other cases we see some third hybrid must be found. We want to be aware of subtle male and female aspects in the construction of society so that we are better able to see choices—choices for ourselves and for our children.

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About the Author

The author is visiting the Institute for Mathematical Sciences in Chennai (IMSC) for two months where she is part of a research group in an area of theoretical computer science called Parameterized Complexity. Additionally, she is passionate about mathematical sciences popularization and has given workshops at six elementary and secondary schools in Tamil Nadu and Kerala as well as a workshop for teachers at the IMSC. She earned her doctorate in mathematics and education at Cornell University in 1981. She is Full-Professor and has chaired the department of mathematics and natural sciences at National University in San Diego, California for the past fifteen years and most recently is Senior Lecturer in the School of Mathematical and Computing Sciences at Victoria University of Wellington, New Zealand.